CURRENT CONCEPTS REVIEW

Allergic Contact Dermatitis (ACD) to Topical Products in Orthopedic Surgery: Clinical Characteristics and Treatment Strategies

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Abstract

The potential for many of the commonly used surgical site wound adhesives, skin antiseptic solutions, topical antibiotics, and suture materials to sensitize and subsequently result in allergic contact dermatitis (ACD) has become increasingly recognized within orthopedic surgery. Particularly with subsequent exposure to the offending allergen, the cutaneous allergic reaction may present in a similar fashion to cellulitis, thus making early differentiation between the two etiologies to initiate the appropriate and timely treatment crucial. Recognition of the characteristic appearance and severity of ACD surrounding a surgical wound often drives the initial management. This typically consists of anti-histamines, topical corticosteroids, and possible removal of the offending allergen for low grade findings and oral steroids and prophylactic oral antibiotics for the more severe reactions. Multidisciplinary care, including the expertise of a dermatologist or wound care specialist when faced with this challenging clinical scenario is critical and elective patch testing may be indicated to ascertain the exact allergen involved, particularly in patients with a prior history of wound issues. Finally, any clinical cases of ACD following an orthopedic procedure should be documented in the patient's chart so that exposure can be avoided with any future surgery.

Level of evidence: III

Keywords: Allergic contact dermatitis, Orthopedic surgery, Topical products

Introduction

One of the most concerning post-surgical complications following orthopedic surgery is wound infection. However, cellulitis is not the only skin condition that can result in erythema and edema postoperatively, emphasizing the necessity for clinicians to better understand the other potential etiologies. The increased use of medical adhesives in wound repair, for instance, has led to a body of literature detailing the possibility of sensitization and resulting allergic contact dermatitis (ACD) that may result from these closure materials. In addition to medical adhesives, many commonly used pre- and post-surgical cleansing agents, dressings and topical antibiotics may result in a similar cutaneous presentation. ACD is considered a common condition, occurring in up to 20% of the general population with a higher risk amongst patient with a history of childhood eczema.[1] it is a delayed type IV hypersensitivity reaction, which requires a sensitization stage during which an individual first comes into contact with a chemical allergen. A repeat exposure then leads to the clinical presentation of a dermatitis. The initial contact may lead to skin findings in 10 to 14 days; however, subsequent exposure typically elicits an allergic reaction within hours to a few days at most. Similar to cellulitis, ACD may cause erythema and edema surrounding the surgical site, though the border of the ACD is often well-demarcated and the eruption papular in appearance. It will frequently be linear or geometric in shape, with the causative agent even hinting at the origin of the eruption. For instance, reactions due to antiseptic washes may appear as streaks or brush

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strokes, whereas those from a dressing often mimic the shape of the material utilized. Finally, whereas cellulitis is often tender or painful, ACD will result in pruritus (itchiness) instead. Due to their inflammatory nature, increased warmth and vesicle formation may be present in both conditions. The following review illustrates the most common antiseptic, adhesive and antibiotic allergens used in orthopedic surgery and addresses subtle clinical differences that can help establish the diagnosis of an ACD, in addition to methods of initial treatment.

Materials and Methods

Adhesives

Acrylates are plastic materials that are found in numerous products, including paints, varnishes, cements and glues.[2] The first commercially available topical skin adhesive, 2-octylcyanoacrylate (Dermabond, Ethicon Inc, Somerville, NJ) was approved by the FDA in 1998.[3] Prior to that, common routes of skin exposure to acrylates were secondary to artificial nail and dental material use.[4] Dermabond is comprised of 2-octylcyanoacrylate and the colorant D&C Violet No 2 and, once applied, polymerizes in an exothermic reaction. The liquid adhesive may currently be used alone or in combination with a self-adhesive polyester mesh. (Prineo Skin Closure System, Ethicon Inc., Somerville, NJ). These types of adhesive wound closure options have continued to increase in popularity given their many favorable qualities in the closure of low tension surgical sites such as decreased application time versus sutures, the absence of suture markings and their barrier-like nature.[5,6] Several clinical studies comparing the use of Prineo to either staple[7] or subcuticular suture closure[8] following total knee arthroplasty have demonstrated equivalent or superior cosmesis and patient satisfaction with the Prineo. Within the orthopedic literature, multiple cases of both suspected and patch test-confirmed ACD to Dermabond alone[9-12] and to the Dermabond Prineo system[13-17] have been published, with far fewer cases of ACD following application of Mastisol [Table 1].[18,19] Each of these adhesives has been shown to provide adequate strength for post-surgical wounds, though the relatively higher cost of Dermabond remains an issue.[5]

Table 1. Studies outlining cutaneous allergic reactions to common topical adhesives in orthopedic surgery

Study	Publication date	Patient # (%)	Age	Gender	Type of Surgery	Postoperative onset cutaneous reaction	Clinical presentation	Intervention and Resolution
Dermabond								
Gonzalo-Garijo et al[9]	2009	3	12	NR	Genu valgum correction	1-2 weeks	Initial pruritus (2-3 days) followed by papulo-vesicular eruptions at surgical site	Patch testing: Dermabond (+). Complete resolution within 15-20 days following use of topical corticosteroids
			14	NR	Bone lengthening for achondroplasia	1-2 weeks	Initial pruritus (2-3 days) followed by papulo-vesicular eruptions at surgical site	Patch testing: Dermabond (+). Complete resolution within 15-20 days following use of topical corticosteroids
			16	NR	Pes planus correction	1-2 weeks	Initial pruritus (2-3 days) followed by papulo-vesicular eruptions at surgical site	Patch testing: Dermabond (+). Complete resolution within 15-20 days following use of topical corticosteroids
El-Dars et al[10]	2010	1	66	F	Patello-femoral joint replacement	Immediately after surgery w/ increasing severity 4 weeks postoperatively	Immediate eczematous rash followed by itching, erythema, vesicles, and blisters at surgical site	Patch testing: Dermabond (+). Resolution with topical fluticasone propionate 0.005% ointment and emollient application
Durando et al[11]	2014	15 of 912 (1.7%)	NR	NR	TKA	NR	Reaction ranging from erythematous papules with minor pruritus to vesicles and bullae surrounding surgical site	Underwent patch testing with (+) result. Resolution within two weeks following treatment with topical corticosteroids

Table 1. Continued

			NR	NR	TKA	NR	Reaction ranging from erythematous papules with minor pruritus to vesicles and bullae surrounding surgical site	Underwent patch testing with (+) result. Resolution within two weeks following treatment with topical corticosteroids
			NR	NR	TKA	NR	Reaction ranging from erythematous papules with minor pruritus to vesicles and bullae surrounding surgical site	Underwent patch testing with (-) result. Resolution within two weeks following treatment with topical corticosteroids
Yagnatovsky et al[12]	2017	3	30	F	Open tibial tubercle osteotomy	8 days	Pain, erythema, and swelling surrounding surgical site along with minor dehiscence of surgical wound	Underwent patch testing with Dermabond with (+) result. Resolution following revision wound closure to address dehiscence
			36	M	ACLR with a bone-patella tendon-bone allograft	8 days	Erythema and swelling surrounding surgical site	Underwent patch testing with Dermabond with (+) result. Resolution within 3 weeks following treatment with diphenhydramine 25mg oral nightly and cephalexin 500mg
			33	F	Open osteochondral allograft implantation to the patella	7 days	Maculopapular rash and erythema surrounding surgical site	Underwent patch testing with Dermabond with (+) result. Resolution within one week following treatment with triamcinolone cream
Prineo Dermabond								
Chalmers et al[13]	2017	29 of 6008 (0.5%) with 4 cases highlighted	47	F	Clavicle ORIF	10 days	Maculopapular rash with pruritus (mild response) surrounding surgical site	No patch testing performed. Resolution 18 days postop with administration of oral antihistamines and Dermabond removal from surgical site
			79	M	UKA	7 days	Pruritus with erythematous papules and vesicles (moderate response) surrounding surgical site	No patch testing performed. Resolution 17 days postop with topical steroids and Dermabond removal from surgical site
			72	F	TKA	19 days	Severe pruritus, erythema, blistering, and bullae (severe response) surrounding surgical site	No patch testing performed. Resolution 21 days postop with oral antihistamines and oral and topical steroids as well as Dermabond removal 5 days postoperatively

Table 1. Continued

			16	M	Knee extensor mechanism realignment and tibial tubercle osteotomy	8 days	Severe pruritus, erythema, blistering, and bullae (severe response) surrounding surgical site	No patch testing performed. Resolution 30 days postop with topical steroids and Dermabond removal from surgical site
Chan et al[14]	2017	3 of 366 (0.8%)	66	M	TKA	5 days	Mild erythema along surgical wound followed by progression to erythematous papules and 1-2mm vesicles one week after removal of Dermabond closure	Treatment with topical corticosteroids with resolution of symptoms after 4 weeks of treatment
			56	F	TKA	4 days	Blistering at and drainage from surgical site	No treatment with resolution 3 months following removal of Dermabond dressing
			60	M	TKA	9 days	Erythematous crusted and scaly plaque surrounding surgical site	Treatment with topical corticosteroids with resolution after 2 weeks of treatment
Pate et al[15]	2020	1	61	F	HHA	8 days	Inflammed wound with gapping and serous drainage	Plastic surgery for scar debridement and STSG, resolution at 3 months
Lee et al[16]	2021	1	NR	NR	TAA	NR	NR	Resulted in deep infection requiring debridement and implant revision
So et al[17]	2021	4 of 143 (2.8%)	71	F	THA	6 days	Eczema/pruritis around incision	Removal of mesh, one dose IV antibiotics and topical steroids with resolution in 1 week
			30	M	ORIF distal tibia fracture	4 weeks	Eczema/vesicular lesions about surgical sites	Removal of mesh, oral antibiotics x 3 days and topical steroids with resolution in 4 weeks
			37	F	ORIF ankle fracture	4 weeks	Eczema/papulovesicular lesion about surgical site	Removal of mesh, topical steroids and anti-histamines with resolution
			62	F	NR	6 weeks	Eczema/vesicular lesions about surgical sites	Removal of mesh, topical steroids and anti-histamines with resolution in 6 weeks

Table 1. Continued

Mastisol								
Ezeh et al[18]	2022	1	20	M	Soft-tissue releases	4 days	Large fluid-filled bullae and vesicles surrounding surgical site	Resolution at 3 weeks following treatment with diphenhydramine, Prednisone 60mg (5 days) and cephalexin 500mg (10 days)
Hood et al[19]	2016	1	39	F	Bunionectomy	6 days	Vesicular dermatitis over forefoot	Resolution at 3 months following treatment with topical steroids, oral steroid taper, and cephalexin

TKA: total knee arthroplasty; NR: not recorded; UKA: unicompartmental knee arthroplasty; TAA: total ankle arthroplasty; HHA: hemiarthroplasty; STSG: split thickness skin graft; ORIF: open reduction and internal fixation; ACLR: anterior cruciate ligament reconstruction; ACD: allergic contact dermatitis

The first case reported of an ACD reaction was published in 2008 after its use in the closure of an abdominoplasty incision.[3] This causality was confirmed with an open patch test of the Dermabond placed on the forearm, which elicited the same reaction seen at the surgical site. Since then, several series of ACD describing application of Dermabond following orthopedic procedures have arisen [Figure 1].[9-12] In a large series of patients undergoing total knee arthroplasty (TKA), Durando and colleagues found that 1.7% (15/912 cases) developed ACD about the surgical site in the setting of Dermabond use and all cases resolved with use of topical steroids.[11] Three of the 15 suspected cases underwent patch testing, with 2 yielding a positive result to the Dermabond.

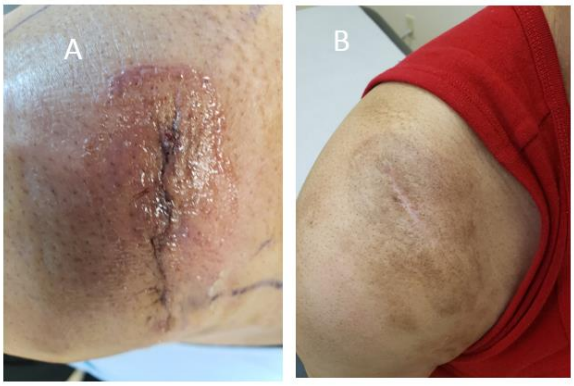

Figure 1. Clinical image of 78-year old female who presented 3 weeks status post excision of right acromioclavicular joint ganglion cyst and distal clavicle excision with incision closed with 3-0 Monocryl sutures and Dermabond. The primary complaint was itchiness in the absence of fevers. (a) Clinical images at 3 weeks. Note the vesicles at the proximal portion of the incision with the cutaneous changes outlining the Dermabond; (b) Image demonstrating resolution of skin findings 4 weeks after removal of Dermabond, use of diphenhydramine and prophylactic Keflex

Prineo wound closure system

Prineo is a wound closure system that combines Dermabond with a self-adhering polyester mesh that is utilized in conjunction with subcutaneous sutures [Figure 2]. The advantages of the Prineo system include its ease of removal, the ability to reduce tension at the wound edges, its creation of a antimicrobial barrier and reduction in closure time. Using Prineo for elective orthopedic procedures, Chalmers et al reported an estimated prevalence of ACD at 0.5%, with 86% of the reactions described as moderate or severe.[13] None of the patients in this series underwent patch testing and the diagnosis of ACD was based on resolution of symptoms following removal of the suspected allergen and use of topical or oral steroids. Interestingly, half of the cases had either suspected or definite prior exposure to the adhesive.

Chan and colleagues presented 3 cases of ACD following application of Prineo following primary total knee arthroplasty and reported a prevalence of 0.8%.

In each case, removal of the Prineo, the use of prophylactic oral antibiotics, topical corticosteroids in 2 of the cases, and referral to a dermatologist resulted in complete resolution of the reactions without adverse clinical effect.[14]

In a prospective study of total ankle arthroplasty closed with Prineo versus interrupted Prolene sutures, Lee and colleagues found 1 case of ACD (2.8%) in the Prineo group which resulted in a deep surgical site infection (SSI).[20] The authors recommended caution with use of Prineo in areas of thin soft tissue envelopes. In contrast to the relatively low prevalence of ACD demonstrated by the prior studies, So and colleagues found that 2.8% of their cohort demonstrated ACD following exposure to the adhesive.[17] This finding may be a result of increased awareness by surgeons of its potential occurrence following use of the adhesive, in addition to increasing patient exposure to acrylates in other common products.

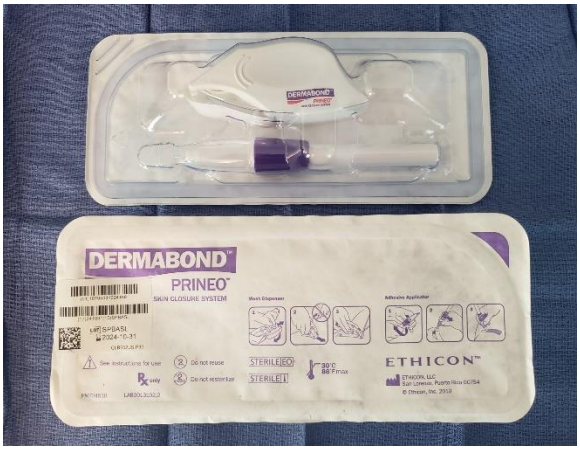

Figure 2. Image depicting the Prineo Skin Closure System (Ethicon Inc., Somerville, NJ, USA). The kit contains a mesh dispenser, in addition to the Dermabond (Ethicon Inc, Somerville, NJ, USA) adhesive applicator device

Mastisol

Mastisol (Ferndale Laboratories, Ferndale, MI) is a liquid adhesive that is typically used in conjunction with wound closure strips and offers a lower cost alternative to 2-octylcyanoacrylate [Figure 3]. Ezeh et al reported a case of ACD following application of Mastisol to the surgical site at the elbow, forearm and wrist following release of soft tissue contractures in a 20-year old male with cerebral palsy.[18] The presenting postoperative symptom was pruritis and the surgical sites demonstrated bullae and vesicles. Treatment included application of clobetasol topical steroid ointment and a petroleum jelly-coated dressing, in addition to oral Prednisone and prophylactic antibiotics with resolution of cutaneous changes at 3 weeks [Table 1].

Figure 3. Image depicting Mastisol (Ferndale Laboratories, Ferndale, MI, USA) liquid adhesive

Antiseptics

All surgical procedures are preceded by the topical application of antiseptic preparations. These agents are applied to the skin to sterilize the skin upon contact and then have a suitable duration of action to continue to provide protection during the course of the surgery.[21] The two most commonly used products are povidone-iodine (PVP-I) preparations, such as DuraPrep (3M, St. Paul, MN) which contains iodine povacrylex and 74% isopropyl alcohol [Figure 4], and chlorhexidine gluconate, such as ChloraPrep (Becton Dickinson, United Kingdom) which contains 2% chlorhexidine gluconate in 70% isopropyl alcohol [Figure 5].

Figure 4. Image depicting the DuraPrep (3M, St. Paul, MN, USA) preoperative skin preparation applicator which contains iodine povacrylex and 74% isopropyl alcohol

Figure 5. Image depicting the ChloraPrep Hi-Lite Orange (Becton Dickinson, United Kingdom) preoperative skin preparation applicator which contains 2% chlorhexidine gluconate in 70% isopropyl alcohol, in addition to FD&C yellow #6 dye

Povidone Iodine (PVP-I)

Iodine was first used for its germicidal properties in the mid-1800s and, since that time, the topical preparation has evolved into PVP-I. In this formulation, the bound iodine reduces cutaneous and oral toxicity and prolongs its germicidal activity.[22,23] PVP-I has been reported as the most common surgical antiseptic to result in ACD.[24] When suspecting ACD to an iodine-based preparation, referral for extended series patch tested is suggested. This should be done to prevent recurrent episodes of post-surgical ACD as approximately 50% of ACD cases to an iodine-based preparation involve a non-iodine allergen.[21] Marks reported on a case of a male patient who had previously undergone surgical repair of an Achilles tendon rupture. A PVP-I dressing was applied for a subsequent non-healing ulcer which resulted in an erythematous, papulovesicular rash which was confirmed with patch testing.[22] De la Cuadra-Oyanguren and colleagues reported on 7 cases of post-surgical patch test-confirmed contact dermatitis to PVP-I,

including 3 elective orthopaedic procedures and concluded that the condition was likely underdiagnosed.[25]

Chlorhexidine

Chlorhexidine-based antiseptics have been used since the 1970s and are often preferred over iodine-based products due to their broad-spectrum antibacterial coverage, more rapid action and persistent activity despite exposure to bodily fluids. A recent meta-analysis of 8 randomized controlled trials of elective clean orthopedic procedures, of which 6 involved surgical intervention, comparing the use of alcoholic chlorhexidine and povidone-iodine skin prep found no significant difference in the incidence of surgical site infection (SSI) though the overall prevalence of SSI was low in the included studies. However, the pooled results demonstrated the superiority of chlorhexidine over povidone-iodine with regards to post-preparation positive skin culture.[26] given the increased use of chlorhexidine surgical preparations, there has been an increase in reported ACD cases such that, in 2015, chlorhexidine digluconate was added as a screening allergen to the North American Contact Dermatitis Group (NACDG) standard series. From 2015 to 2018, 0.8% of patients patch-tested in the NACDG studies had a positive reaction to this antiseptic.[21]

As with other antiseptics, chlorhexidine products include other chemicals that can act as allergens. ChloraPrep with Tint (Becton Dickinson, United Kingdom) is an antiseptic preparation comprised of chlorhexidine gluconate, isopropyl alcohol and Sunset Yellow (E110) dye. Lauriola et al reported on 2 cases of ACD following rotator cuff repair and flatfoot reconstruction that patch tested positive to ChloraPrep with Tint, though testing for each individual component was negative.[27] the authors concluded that this was an unusual case of a compound ACD meaning that the components may have interacted to create a new allergen. Each case resolved with the use of oral and/or topical steroids. Several others have reported on ACD following use of chlorhexidine skin preparations prior to elective orthopedic procedures [Table 2].[28,29] Isopropyl alcohol has also been demonstrated to incite ACD in 3% of patients with a history of isopropyl alcohol exposure.[30]

Although patch testing remains the gold standard for definitive diagnosis of ACD, it may not be readily available to a post-operative patient. Clinically, however, the involved skin will demonstrate an erythematous, papulo-vesicular eruption though the borders of the skin eruption will often be less well-defined than that seen with an adhesive. Additionally, the area of skin involvement is often not contiguous with the surgical site as the antiseptics can often come into contact with uncovered adjacent areas of skin.[25]

Table 2. Studies outlining allergic contact dermatitis (ACD) to skin antiseptics in orthopedic surgery

Study	Publication date	Age	Gender	Type of Surgery	Postoperative onset cutaneous reaction	Clinical presentation	Intervention and Resolution
Povidone-Iodine (PVP-I)							
De la Cuadra-Oyanguren[25]	2014	67	M	Right hand surgery	24 hours	Acute dermatitis affecting surgical site, in addition to upper arm and forearm	Patch testing with 10% PVP-I in petrolatum yielded (+) results. Resolution with symptomatic treatment
		55	M	Bone biopsy right tibia	2 days	Dermatitis affecting surgical site with isolated pustules and papules	Patch testing with 10% PVP-I in petrolatum yielded (+) results. Resolution with symptomatic treatment
		61	F	TKA	NR	Dermatitis at the surgical field	Patch testing with 10% PVP-I in petrolatum yielded (+) results. Resolution with symptomatic treatment
Chlorhexidine							
Dick et al[28]	2019	40	M	Hallux MTP joint fusion	<24 hrs	Erythema lower limb with elevated eruptions from thigh to foot	Did not undergo patch testing. Resolution ~ 2 weeks with oral flucloxacillin and betamethasone

Table 2. Continued

		71	F	Right 5th hammertoe correction	2 days	Erythema lower limb with elevated eruptions from thigh to foot	Did not undergo patch testing. Resolution ~ 2 weeks with single dose Prednisone, certirizine, betamethasone, and topical emollients
Kalthoff et al[29]	2019	39	M	Right hip arthroscopy	3 days	Erythematous maculopapular rash over operative hip, abdomen and thigh	Treatment with oral and topical corticosteroids with resolution of symptoms after 1 week of treatment
Lauriola et al[27]	2021	54	M	Right RTC reconstruction	10 days	Erythemato-edematous and vesicular reaction in right deltoid, axilla, arm and hemithorax	Patch testing with ChloraPrep with Tint yielded (+) results. Resolution with oral/topical steroids and antibiotics
		36	F	Flatfoot reconstruction	Few days	Erythematous and vesicular eruption right lower limb	Patch testing with ChloraPrep with Tint yielded (+) results. Resolution with topical steroids

TKA: total knee arthroplasty; NR: not recorded; PVP-I: povidone-iodine; MTP: metatarsophalangeal; RTC: rotator cuff; ACD: allergic contact dermatitis)

Sutures

Hypersensitivity to suture material generally has been found to be less common amongst the synthetic absorbable sutures comprised of polyglactin 910 (ie Vicryl, Ethicon Inc, Somerville, NJ) and poliglecaprone 25 (Monocryl, Ethicon Inc, Somerville, NJ), and low amongst non-absorbable sutures such as nylon[31] and polypropylene[32] (Prolene, Ethicon Inc, Somerville, NJ). The typical irritant reaction may cause erythema directly adjacent to the suture site and is fairly straightforward to diagnose. However, in recent decades, suture material coated with the antibiotic triclosan has become popular as a means to inhibit bacterial proliferation at the surgical site [Figure 6]. Triclosan-coated sutures were first approved by the FDA in 2002 and have been recommended by the WHO and CDC for prevention of surgical site infection base on low-to-moderate quality evidence.[33] An estimated one third of coated vicryl sutures sold in the United States are antibacterial and a case of ACD to triclosan-coated sutures has been reported.[34] However, in general, triclosan has been investigated as an allergen and has been found to have a low sensitizing potential. Other suture additives have also been associated with ACD, including ethylene oxide, a chemical used in the sterilization of sutures,[35] and acid blue 158, an azo dye.[36] Hypersensitivity has also been reported following the use of chromated catgut suture [Figure 7].[37] The clinical differentiation of a delayed foreign body reaction to suture material and ACD can often be challenging for the clinician, though histology and patch testing will provide a definitive diagnosis.[38] Although there are often no commercially available patch tests for sutures, it has been suggested that placing a single interrupted suture of the type thought to cause the allergic reaction in the lower back area and observing for edema and erythema at 48 and 72 hours can evaluate for hypersensitivity.[39]

Topical Antibiotics

Bacitracin, neomycin, and silver sulfadiazine (silvadene) are commonly used by healthcare professionals in the setting of abrasions, perioperative blistering or superficial infections around a surgical site. Bacitracin gained popularity in the 1950s following its accidental discovery in 1943 and, along with neomycin, continues to be used commonly today.[24] As a result of their increased use and availability, both bacitracin and neomycin are associated with high rates of ACD. The

North American Contact Dermatitis Group Patch Test Results from 2017-2018 found that 5.5% (274 of 4937) of participants developed positive reactions to bacitracin.[40] Similar results were seen with neomycin sulfate, with 5.4% (269 of 4938) of participants developing positive reactions. Although not included in the 2017-2018 report, ACD has also been known to arise following use of silvadene with the allergen being either the silver or sulfadiazine component.[41,42] ACD arising from topical antibiotics often presents as local edema, erythema, and pruritus, with bullae and pustules occurring in more severe cases. Due to the increase in cases of ACD in response to these topical antibiotics, many clinicians have promoted the use of white petrolatum to promote wound healing in cases of post-surgical wounds instead of using topical antibiotics.[43]

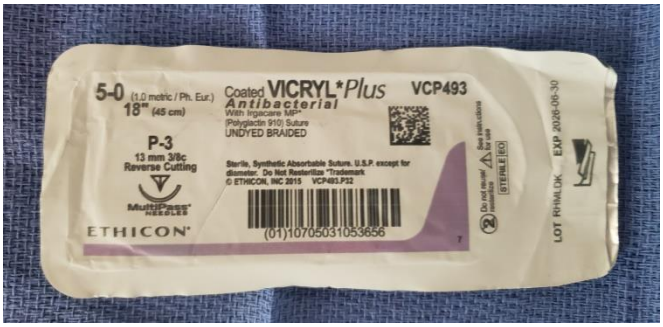

Figure 6. Image depicting Vicryl Plus (Ethicon, Inc, Somerville, NJ, USA) coated antibacterial undyed braided sutures using triclosan

Figure 7. Image depicting chromacized catgut (Ethicon, Inc, Somerville, NJ, USA) suture

Aquacel Ag (ConvaTec Inc., Greensboro, NC) represents a commonly utilized surgical dressing that is composed of a core hydrofiber layer with silver ions that absorbs wound exudate to form a gel and provide antimicrobial protection. In a prospective, randomized trial assessing the efficacy of Aquacel Ag in preventing surgical site infections following minimally invasive total knee arthroplasty, Kuo and colleagues reported five cases of a resultant skin allergy manifested by skin itching and erythema. Those patients were switched to standard post-surgical dressings and dropped from the study group.[44] the allergic reaction has been reported to the silver ions or to the hydrocolloid component of the dressing. A metal ion allergy has, therefore, been given as a contraindication to the use of Aquacel Ag.[44]

Diagnosis and Treatment

Many chemicals applied to the skin throughout the course of a surgical procedure may cause an allergic contact dermatitis, often making discovery of the exact offending agent difficult. As such, the diagnosis and management of a postoperative ACD should involve a multi-disciplinary effort including consultations with dermatology and wound care specialists. During the initial evaluation, usually undertaken in the outpatient orthopedic office setting, it is essential to note the characteristics of the cutaneous changes. Although ACD will cause erythema and edema about a wound site similar to infection, it is often well-demarcated in a geometric shape and patients endorse itchiness about the site. Furthermore, the patient may have experienced a similar reaction in the past when questioned, suggesting prior exposure and sensitization to the allergen. Although routine pre-operative patch testing is not recommended, a patient screening question inquiring about prior episodes of surgical wound issues is advisable. For definitive diagnosis, a dermatologist would perform patch testing to both a standard allergen series and the suspected allergen. A standard series of allergens must be performed as cyanoacrylates, for instance, also contain formaldehyde. Additionally, although an ACD to an adhesive may be suspected from clinical appearance alone, many pre- and postoperative topical agents may be implicated and determining the exact allergen can help avoid a repeat episode of dermatitis at a subsequent procedure. During patch testing, chemical allergens are placed on the skin of the back, left in place for 48 hours and then evaluated. It is typical that a second reading will be done 24 to 72 hours after the first.

ACD to an adhesive surgical closure may present a unique series of challenges for the surgeon as removal of the causative allergen is often needed to improve the dermatitis and inflammation about a surgical site, even if not infectious, and may complicate wound healing and lead to dehiscence [Table 3]. In the immediate post-operative period, removal of the allergen is necessary as inflamed skin will delay wound healing. If the surgical barrier has been compromised, or evidence of a secondary bacterial infection is noted, coverage with appropriate antibiotics is suggested. In addition to antibiotics, a topical corticosteroid is recommended to decrease pruritus and inflammation of the affected skin. The International Contact Dermatitis Research Group (ICDRG) has proposed a classification of the clinical presentation of ACD upon which general treatment can be based.[46] Grade 1 (mild reaction) manifests as erythema without the presence of vesicles and may initially be treated with removal of the suspected allergen and use of anti-histamines for symptomatic relief. Grade 2 (moderate reaction) manifests as erythema with the presence of vesicles and may be treated with removal of the suspected allergen, in addition to use of anti-histamines and topical corticosteroids. Grade 3 (severe reaction) manifests as coalescing vesicles and consideration

should be given to the use of oral corticosteroids. Examples of prescription-based topical corticosteroids for moderate reactions include triamcinolone acetonide 0.1% or mometasone furoate 0.1%. For more severe reactions, clobetasol propionate 0.05% or halobetasol propionate 0.05% should be considered. Finally, in those cases with suspected or patch testing-proven ACD, it is crucial for the treating surgeon to document the patient's reaction in the medical record so that any future provider can avoid exposing the patient to the offending allergen.

Table 3. General treatment algorithm based on allergic contact dermatitis (ACD) reaction severity

Grade of Reaction	Clinical Characteristics	Acute Treatment	Aftercare
Mild	Erythema No vesicles Itchiness No pain	Standard wound care Medium-potency topical corticosteroids * Oral anti-histamines	Avoidance of allergen Dermatology referral for possible patch testing
Moderate	Erythema Mild edema Vesicles Itchiness ± Tenderness	Removal of allergen High-potency topical corticosteroids ** Oral anti-histamines Consider oral corticosteroids Consider oral antibiotics Dermatology referral	Avoidance of allergen Dermatology referral for patch testing
Severe	Erythema Edema Vesicles and bullae Itchiness Tenderness	Removal of allergen High-potency topical corticosteroids ** Oral anti-histamines Oral corticosteroids Oral antibiotics Dermatology referral	Avoidance of allergen Dermatology referral for patch testing

* Triamcinolone acetonide 0.1% or mometasone furoate 0.1%

** Clobetasol propionate 0.05% or halobetasol propionate 0.05%

Conclusion

The increasing development of ACD to topical agents commonly utilized during the perioperative setting in orthopedic surgery has made the clinical differentiation of ACD from surgical site cellulitis crucial, particularly with the more severe reactions. Remaining up-to-date with the surgical products that have been associated with ACD, and recognizing the typical cutaneous appearance, patterns of skin involvement and patient symptoms (ie, pruritis, afebrile) seen with ACD, will certainly help the practicing orthopaedic surgeon to undertake the most appropriate initial treatment. Recalcitrant cases, and those that have recurred with subsequent surgeries, may be managed with the assistance of a dermatologist.

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